CAIS STANDARD MANUAL

SYSTEM NO. 22
ORDNANCE

CAS PROJECT
CAIS MANUAL

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MEMORANDUM FOR DTIC-OCP
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FROM: AL/EQ (STINFO)
139 Barnes Drive. Suite 2
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SUBJECT: Transmision of Technical Documents

1. As per telephone conversation with Andrew Poulis, EQ/TIC, the attached CAIS CTDS manuals are forwarded for accession, cataloging, and microconversions. Please forward the accession numbers to:

Andrew Poulis
AL/EQ/TIC
139 Barnes Drive. Suite 2
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2. The Distribution statement should read as follows: Approved for Public Release: Distribution Unlimited.

3. If you have questions about these documents, please contact Andrew Poulis at DSN 523-6285.

Larry L. Testerman
LARRY L. TESTERMAN
Scientific and Technical
Information Program Manager

Atchs: Manuals

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ABSTRACT

GENERAL ORGANIZATION

At this installation the list of facilities to be surveyed will be addressed on the basis of 32 unique systems that form the CAIS Engineering Deficiency Standards and Inspection Methods document. Each system deals with a specific technical aspect of the facility to be surveyed. Within each system a further breakdown is made to subsystems, each having a specific list of components. Specific observations of the listed defects are provided so as to allow the entry of observed quantification data. A DOD CAIS manual is provided for each of the 32 systems with an internal organization as outlined below:

INSPECTOR'S GUIDE

I. General
   - A. Level I Inspection Method Description
   - B. Level II Inspection Method Description
   - C. Level III Inspection Method Description

II. General Inspection
   - A. Process. This section describes the process of the inspection activity.
   - B. Location. This section describes the procedure for locating the inspection units in the facility or infrastructure on this installation.

III. Inspector Qualifications
   This section notes the minimum qualifications for the person or persons performing the survey.

IV. Inspection Unit
   This section describes how the IU (Inspection Unit) is determined for the particular component being surveyed.

V. Unit Costs
   This section notes the nature of repair costs for this system.

VI. Standard Safety Requirements
   This section lists safety procedures and equipment required to implement a safe environment for the conduct of this survey.

VII. Standard Tools
   This section lists a set of standard tools required for the general conduct of this survey.

VIII. Special Tools and Equipment Requirements
   This section refers to special tools or equipment requirements endemic to the nature of the system being surveyed.

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IX. Level II Inspection Method Keys
This section explains the use of keys as they relate to Level II Guide Sheets.

X. Level III Inspection Method Keys
This section explains the use of keys as they relate to Level III Guide Sheets.

XI. Replacement Cost
This section describes the nature and location of replacement cost data.

XII. Appendices
Appendix A. Provides a listing and definition of all abbreviations used both in the Standards and in the data base.

Appendix B. Provides a glossary of terms with their definitions as used in the Standard.

Appendix D. This section contains a listing of the average life cycle durations for each assembly* in the Standard.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

SYSTEM TREE

The System Tree is a graphical representation of the Work Breakdown Structure, showing system, subsystem and component relationships for the Ordnance System.

INSPECTION METHODS

Description
Describes the nature of what is to be condition surveyed.

Special Tool and Equipment Requirements
Lists any special tools required for this specific subsystem.

Special Safety Requirements
This section outlines any special safety measures or equipment required for this specific subsystem so as to maintain a safe environment and process in the conduct of the condition survey.

Component List
All components to be surveyed under this subsystem are listed here.

Related Subsystems
All other subsystems that have a survey relationship to this subsystem are listed here to help coordinate a complete and thorough condition assessment survey.

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Standard Inspection Procedure

This statement indicates the various levels of survey effort required for this subsystem.

Components

The previously listed components of this subsystem are described with a survey procedure recommended on a component by component basis. For each component there is a listing of defects with each defect broken down into observations describing the nature and severity of the defective condition observed. The surveyor enters a quantification value for each defect/observation encountered in the field CAIS device (DCD) to record the result of his survey.

References

This page lists the reference sources from which the foregoing subsystem data was developed.

Guide Sheet Control Number

This section lists the key numbers that tie the written Level II and Level III guide sheets to specific components in this subsystem.

Level II and Level III Inspection Method Guide Sheets

This section contains the detailed descriptions of the Level II and III survey and inspection procedures for this subsystem.

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INSPECTOR'S GUIDE

I. GENERAL

A. Level I Inspection Method

The Level I Inspection Method of ordnance systems consists of a thorough inspection of each subsystem and component as described in the Work Breakdown Structure. The survey activity is designed to be performed by a single surveyor.

B. Level II Inspection Method

The Ordnance System does not include any Level II inspections. Specialized training and/or excessive inspection time is needed to provide information which is substantially more detailed than that obtained by a Level I inspection. Therefore, further inspections will necessitate a Level III effort.

C. Level III Inspection Method

The Level III inspection is triggered by defect/observations occurring in the Level I and II inspections. The Level III inspection can also occur as a result of time based scheduling, antidotal experience, or component age compared to its life cycle. The Level III inspection is referenced through a Level III key which in turn, denotes a specific Guide Sheet describing the Level III inspection process and requirements. Level III inspections produce a detailed, written engineering assessment of the deficiency along with an estimated cost of correction, and are performed at the option of the Facility Manager.

II. GENERAL INSPECTION

A. Process

Surveys are normally conducted at the component level. Figure 22-A provides the breakdown from system through component for the Ordnance System. The surveyor will work through the Work Breakdown Structure (WBS) to conduct the inspection. At the component level the surveyor will be provided a list of defects, each of which is described further in detail as observations. These observations are described to various levels of severity as they relate to the effect of the life of the system. The quantification of each deficiency is identified by the surveyor using the associated unit of measure. Once an observation is populated with a deficient quantity, the inspector will be requested to provide information on the component type and location. The installation date or age of the component may be preloaded into the WBS for each asset from the Real Property Inventory List or site specific information. If necessary, age data can be overridden by the surveyor, Site CAIS personnel, or the Facility Manager.

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B. Location

Level I inspections will be located by the surveyor through a discrete entry in the Field CAIS. Building floor plans or sketches are required to ensure a complete inspection of all areas and to assist in the location of IU's. The inspection team members must use the recommended room numbering schemes for the installation. The installation may have rooms physically identified by a numbering system or identified on floor plans. If both exist and are different, the Facility Manager will develop guidance on which numbering system takes precedence. Where numbering systems do not exist or are not complete in identifying each space, specific guidance for the inspector to annotate areas in a consistent manner should be developed by the Facility Manager and implemented in the installations CAS process. In all cases, plans and maps shall be orientated with the top of each sheet being the north direction, so as to allow directional location and description. In the case where no other means of location exist the inspector shall enter a brief (65 character) description of location. Locations must be accurate to insure future repeatability and consistent results.

III. INSPECTOR QUALIFICATIONS

The minimum inspector qualification for the Ordnance System requires a five year journeyman. All of the condition survey requirements for this system can be accomplished at the Level I inspection by a single inspector, however, safety and other considerations may require that inspectors work in teams. The inspector or team of inspectors will be specifically trained in the CAS system and its usage and will be CAS certified in all three disciplines, "Civil", "Mechanical" and "Electrical".

IV. INSPECTION UNIT (IU)

The Inspection Unit (IU) is normally defined at the component level for this system. The varied configurations of the components that exist in the Ordnance System require that they be evaluated differently when defining the IU. Therefore, the measurement technique requires some consideration. If the inspector finds multiple defects that occur on the same IU, the inspector will quantify the observation that is considered most severe and identify the remaining quantity under the less severe observation for the discrete component. The following list describes some common IU definitions for the Ordnance System:

- Interior - Concrete: Floor IU's will be defined by expansion joints, wall intersections or any other man-made termination. If no expansion joints exist, the IU will be the total square footage of the surface within the room being inspected.

- Interior - Concrete: Wall IU's will be defined by expansion joints, structural supports, floors, ceilings or any other directional change in the plane of the wall.

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- Exterior Berms - The IU for berms is the total square footage of the surface area, measured by multiplying the length of the wall by the length of the sloped area.

- Exterior Blast Doors - The square footage of the door, measured by multiplying the width by the height.

- Ventilation Systems - The square footage of the vent, measured by multiplying the width by the height.

- Exterior Blast Deflectors - The square footage of the surface, defined by expansion joints or any other directional change in the plane of the deflector.

- Grounding IU, Lightning IU etc. - Singularly defined items such as these are defined as each.

- Interior Drainage Trenches - The length of the trench, defined by expansion joints or any directional change in the plane of the trench (such as the length along one wall).

V. UNIT COSTS

The unit costs that are applied to the quantities recorded for each observation are contained within the Site CAIS as repair cost.

VI. STANDARD SAFETY REQUIREMENTS

The Master Safety Plan will be followed at all times during the condition survey.

Inspector may utilize the following protective gear:

- Hard hat - to be worn during all surveys
- Safety glasses - to be worn during all surveys
- Safety shoes - to be worn during all surveys
- Coveralls - to be worn as necessary
- Gloves - to be worn as necessary
- Ear plugs - to be worn in designated areas
- Knee pads - to be worn when crawling is required
- Rain suit - to be worn as necessary

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VII. STANDARD TOOLS

Employee Identification Card - to be worn or carried during all survey activities
Data Collection Device (DCD)
Battery pack for DCD
Flashlight
Tape measure - 20' (or other supplemental measuring devices)
Screwdrivers - Phillips and straight slot
Pliers
Pocket knife or ice pick

VIII. SPECIAL TOOLS AND EQUIPMENT REQUIREMENTS

At the subsystem level, the deficiency standard has identified special tools and equipment required for the standard inspection of the associated components, which exceed the standard tools identified for the system. Level III Inspection Method Guide Sheets will address additional tools and equipment requirements that are specific to that particular advanced method of inspection.

Facility Managers should review these sections in order to determine any special tool requirements for subsystems they are to inspect/survey.

IX. LEVEL II INSPECTION METHOD KEYS

Certain observations will reference a Level II Inspection Method. The Facility Manager will be able to identify deficiencies where a Level II inspection is flagged. The Level II key at the observation level will refer to a specific guide sheet.

All Level II Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

X. LEVEL III INSPECTION METHOD KEYS

Certain observations will trigger a Level III inspection. The Facility Manager will be able to identify deficiencies where a Level III inspection is flagged. The Level III Key at the observation level will refer to a specific guide sheet. These guide sheets may refer the Facility Manager to a more sophisticated and costly test method.

All Level III Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

XI. REPLACEMENT COST

A replacement cost for each subsystem type will be contained within the cost estimating system in the Site CAIS.

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XII. APPENDICES

Appendix A - Abbreviations

A summary and definition of all abbreviations used in this system are contained in Appendix A which is located at the end of Ordnance.

Appendix B - Glossary

A glossary of terms used in this system are contained in Appendix B which is located at the end of Ordnance.

Appendix C - Life Cycles

A listing of the average life cycle duration for each assembly* in the Standard.

Note - Facility Manager's Guide

The following are included in the Facility Manager's Guide:

A table showing the required manhours to perform the standard inspection for this facility listed by Cat Code (three digit).

A listing of all Level III inspections with their estimated cost and time to perform. This list will include frequency of inspections for time driven Level III's.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

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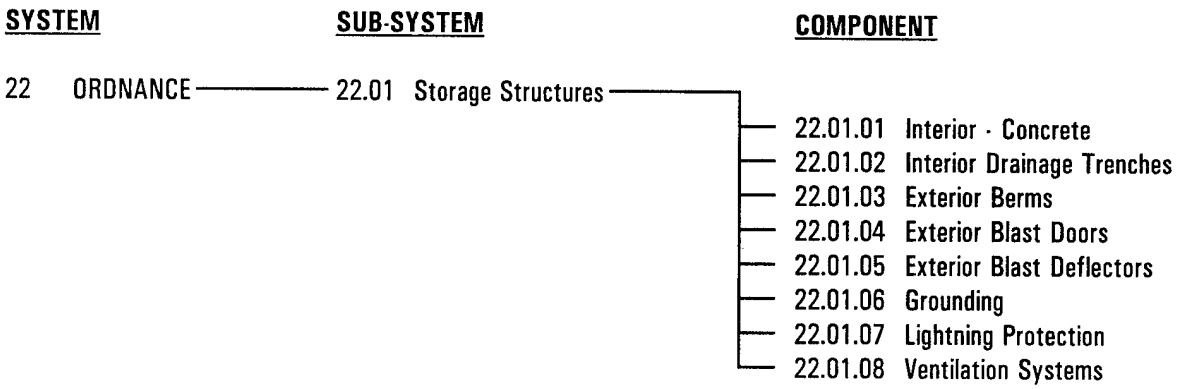
Figure 22-A. WORK BREAKDOWN STRUCTURE



22.01 STORAGE STRUCTURES

DESCRIPTION

Storage Structures is a subsystem of the Ordnance System. Storage Structures are typically constructed of reinforced concrete, arch type and covered by minimum 2 FT of earth. They are normally without lighting or plumbing. The structure can be constructed with or without a loading platform.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Storage Structures, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are needed to perform the inspection of the Storage Structures.

1. Matches, cigarette lighters and other spark producing devices are not permitted in explosive areas.
2. Personal protective clothing and equipment may be required in some areas.

COMPONENT LIST

- 22.01.01 INTERIOR - CONCRETE
- 22.01.02 INTERIOR DRAINAGE TRENCHES
- 22.01.03 EXTERIOR BERMS
- 22.01.04 EXTERIOR BLAST DOORS
- 22.01.05 EXTERIOR BLAST DEFLECTORS
- 22.01.06 GROUNDING
- 22.01.07 LIGHTNING PROTECTION
- 22.01.08 VENTILATION SYSTEMS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

01.02	SLAB-ON-GRADE, BASES AND PITS
02.08	RAMPS
13.06	LANDSCAPING

22.01 STORAGE STRUCTURES

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspections as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

COMPONENTS

◆ 22.01.01 INTERIOR - CONCRETE

Ordnance storage structures are normally poured concrete with exposed interior concrete surfaces. Typically, the structure is covered by a minimum 2 feet of earth.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking.**			
Observation:			
a. Hairline cracks, no loss of surface.	SF		
*** {Severity L}			
b. Medium cracks, less than 1/16" wide.	LF		
*** {Severity M}			
c. Wide cracks, between 1/16" and 1/4" wide.	LF		1
*** {Severity H}			
d. Extensive disintegration of surface or cracks exceeding depth of 2".	SF		1
*** {Severity H}			
*** Spalling.**			
Observation:			
a. Not more than 1" deep or 6" in diameter.	SF		
*** {Severity L}			
b. More than 1" in depth or greater than 6" in diameter, or loss of more than 10 percent of surface area of a member.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		2
*** {Severity H}			

22.01 STORAGE STRUCTURES

COMPONENTS (Continued)

◆ 22.01.01 INTERIOR - CONCRETE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Scaling.**			
Observation:			
a. Loss of surface up to 1/2" deep, with exposure of coarse aggregates.	SF		
*** {Severity L}			
b. Loss of surface from 1/2" to 1" deep, with coarse aggregates clearly exposed.	SF		
*** {Severity M}			
c. Loss of surface exceeding 1" deep.	SF		
*** {Severity H}			
d. Exposure of reinforcing steel.	SF		2
*** {Severity H}			
*** Reinforcing steel corrosion.**			
Observation:			
a. Rusting/discoloration evident, cracks occurring parallel to reinforcement.	SF		2
*** {Severity H}			
*** Popouts.**			
Observation:			
a. Conical holes less than 5/8" in diameter.	EA		
*** {Severity M}			
b. Conical holes greater than 5/8" in diameter.	EA		
*** {Severity H}			

22.01 STORAGE STRUCTURES

COMPONENTS (Continued)

◆ 22.01.02 INTERIOR DRAINAGE TRENCHES

The floor is pitched to a trench that runs along the side and end floor/wall joints.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Improper drainage.**			
Observation:			
a. Dampness in trench at wall outlet.	LF		
*** {Severity M}			
b. Water ponding in trench at wall outlet.	LF		
*** {Severity H}			
c. Damaged or broken concrete chunks in trench obstructing flow.	LF		
*** {Severity H}			

22.01 STORAGE STRUCTURES

COMPONENTS (Continued)

◆ 22.01.03 EXTERIOR BERMS

A berm is a grassy earthen cover or embankment (barricade) provided as protection against blast. It is free of trash, debris and stones heavier than 10 LBS or larger than 6" in DIA and has a slope not to exceed 1 1/2 horizontal to 1 vertical. The crest of the berm must be a minimum of 3 feet wide.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Erosion.**			
Observation:			
a. Evidence of gullies less or equal to 6" deep.	SF		
*** {Severity M}			
b. Evidence of gullies greater than 6" deep.	SF		
*** {Severity H}			
c. Excessive slope (steeper than 1 1/2 to 1).	SF		
*** {Severity H}			
*** Non-cohesive earth cover.**			
Observation:			
a. Debris, trash, deleterious organic matter.	SF		
*** Severity M}			
b. Surface rocks, stones exceeding 10 LBS or 6" DIA.	SF		
*** {Severity H}			
c. Inability to support vegetation.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Exceeds 18" growth.	SF		
*** {Severity M}			
b. Dry debris and brush.	SF		
*** {Severity M}			

22.01 STORAGE STRUCTURES

COMPONENTS (Continued)

◆ 22.01.04 EXTERIOR BLAST DOORS

Typically the doors to an ordnance storage structure are of steel construction that are hinged to fit snugly without sagging or binding. Some doors have louvered vents located in the lower half as part of the ventilation system. The steel doors and framing are connected to the secondary grounding system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective hinges/latches.**			
Observation:			
a. Hinges/latches loose, missing, broken.	EA		
*** {Severity H}			
*** Defective blast relief mechanism.**			
Observation:			
a. Bent counterweight arm.	EA		
*** {Severity M}			
b. Missing counterweight arm.	EA		
*** {Severity H}			
c. Inoperable mechanism.	EA		
*** {Severity H}			
*** Corrosion (including frames).**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

22.01 STORAGE STRUCTURES

COMPONENTS (Continued)

◆ 22.01.05 EXTERIOR BLAST DEFLECTORS

The blast deflector is located in proximity to a door or loading dock. The side facing the activity is a reinforced concrete wall 12" thick at the bottom tapering to about 6" at the top. The slope of this wall is 6' vertical to 1' horizontal. The earthen backside meets the inspection criteria and requirements of a berm.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking.**			
Observation:			
a. Hairline cracks, no loss of surface.	SF		
*** {Severity L}			
b. Medium cracks, less than 1/16" wide.	LF		
*** {Severity M}			
c. Wide cracks, between 1/16" and 1/4" wide.	LF		3
*** {Severity H}			
d. Extensive disintegration of surface or cracks exceeding depth of 2".	SF		3
*** {Severity H}			
*** Spalling.**			
Observation:			
a. Not more than 1" deep or 6" in diameter.	SF		
*** {Severity L}			
b. More than 1" in depth or greater than 6" in diameter, or loss of more than 10 percent of surface area of a member.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		4
*** {Severity H}			

22.01 STORAGE STRUCTURES

COMPONENTS (Continued)

◆ 22.01.05 EXTERIOR BLAST DEFLECTORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Scaling.**			
Observation:			
a. Loss of surface up to 1/2" deep, with exposure of coarse aggregates.	SF		
*** {Severity L}			
b. Loss of surface from 1/2" to 1" deep, with coarse aggregates clearly exposed.	SF		
*** {Severity M}			
c. Loss of surface exceeding 1" deep.	SF		
*** {Severity H}			
d. Exposure of reinforcing steel.	SF		4
*** {Severity H}			
*** Reinforcing steel corrosion.**			
Observation:			
a. Rusting/discoloration evident, cracks occurring along reinforcement and parallel to it.	LF		4
*** {Severity H}			
*** Erosion.**			
Observation:			
a. Evidence of gullies less or equal to 6" deep.	SF		
*** {Severity M}			
b. Evidence of gullies greater than 6" deep.	SF		
*** {Severity H}			
c. Excessive slope (steeper than 1 1/2 to 1).	SF		
*** {Severity H}			

22.01 STORAGE STRUCTURES

COMPONENTS (Continued)

◆ 22.01.05 **EXTERIOR BLAST DEFLECTORS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Non-cohesive earth cover.**			
Observation:			
a. Debris, trash, deleterious organic matter.	SF		
*** {Severity M}			
b. Surface rocks, stones exceeding 10 LBS or 6" DIA.	SF		
*** {Severity H}			
c. Inability to support vegetation.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Exceeds 18" growth.	SF		
*** {Severity M}			
b. Dry debris and brush.	SF		
*** {Severity M}			

22.01 STORAGE STRUCTURES

COMPONENTS (Continued)

◆ 22.01.06 GROUNDING

Grounding is a system of low resistance continuous electrical paths, consisting of ground rods and bare copper cable inter-connecting for dissipation of electrical charges. The primary grounding system provides earth termination for lightning protection with ground rods spaced every 10' along the cable. The secondary system connects all metallic components of ordnance structure including reinforcing rods, steel arches, doors, frames, ventilators and signs, to a buried copper conductor cable no closer than 3 FT from the outside wall of a structure. Bonding measurements and resistance testing is a scheduled Level III PM inspection.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Rod stability.**			
Observation:			
a. Loose in ground or shallowly driven.	EA		
*** {Severity H}			
b. Inadequate number or improperly spaced (1 every 10') primary system.	EA		
*** {Severity H}			
*** Defective cables.**			
Observation:			
a. Corroded, burned, broken strands (2 or more).	EA		5
*** {Severity H}			
*** Defective connections.**			
Observation:			
a. Free from dirt/foreign material.	EA		
*** {Severity L}			
b. Loose, dissimilar metal.	EA		5
*** {Severity M}			
c. Corroded, broken.	EA		5
*** {Severity H}			

22.01 STORAGE STRUCTURES

COMPONENTS (Continued)

◆ 22.01.07 LIGHTNING PROTECTION

A lightning protection system is an arrangement of air terminals electrically bonded with heavy copper cable tied into the primary grounding system. Both the mast and catenary systems use masts that are remote from the structure to provide the primary point for a lightning discharge. The masts should be conductive or have a lightning rod and two down conductors. The catenary system also includes elevated horizontal conductor cable suspended between masts. A minimum 6' separation must be provided from any projection of the protected structure. Bonding measurements and resistance testing is a scheduled Level III PM inspection.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective cables.**			
Observation:			
a. Corroded, burned, broken strands (2 or more).	EA		6
*** {Severity H}			
*** Rod stability.**			
Observation:			
a. Loose in ground or shallowly driven.	EA		
*** {Severity H}			
b. Inadequate number or improperly spaced (1 every 10').	EA		
*** {Severity H}			
*** Defective connections.**			
Observation:			
a. Free from dirt/foreign material.	EA		
*** {Severity L}			
b. Loose, dissimilar metal.	EA		6
*** {Severity M}			
c. Corroded, broken.	EA		6
*** {Severity H}			

22.01 STORAGE STRUCTURES

COMPONENTS (Continued)

◆ 22.01.07 LIGHTNING PROTECTION (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Mast deterioration.			
Observation:			
a. Loose in ground.	EA		
*** {Severity L}			
b. Corrosion evidenced by holes or loss of base metal (metal pole).	LF		
*** {Severity H}			
c. Rotted or parasitical damage greater than 5 percent dimensional loss or holes greater than 1/8" DIA (wood pole).	LF		7
*** {Severity H}			

22.01 STORAGE STRUCTURES

COMPONENTS (Continued)

◆ 22.01.08 VENTILATION SYSTEMS

Each storage facility is normally provided with baffled and screened ventilators. Flappers still in existence are secured with a fusible link and kept free of corrosion and in working order. A grid is normally present immediately below the ventilator to prevent access by its removal. The louvered openings are normally covered with corrosion-resistance metal screens.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Inoperable elements.**			
Observation:			
a. Physically damaged or missing.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

22.01 STORAGE STRUCTURES

REFERENCES

1. NAVSEA OP5, Vol. 1, Fifth Edition

2. NAVFAC MO-322, Vol. 2, Inspection of Shore Facilities, 1993

3. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

4. NAVFAC P-80, Facility Planning Criteria for Navy and Marine Corps Shore Installations, 1982

22.01 STORAGE STRUCTURES

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
N/A	

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 22.01.01-1
2	GS-III 22.01.01-2
3	GS-III 22.01.05-3
4	GS-III 22.01.05-4
5	GS-III 22.01.06-5
6	GS-III 22.01.07-6
7	GS-III 22.01.07-7

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: INTERIOR - CONCRETE
CONTROL NUMBER: GS-III 22.01.01-1

Application

This guide applies to the investigation of cracks in concrete interiors.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: INTERIOR - CONCRETE
CONTROL NUMBER: GS-III 22.01.01-2

Application

This guide applies to the investigation of corrosion of reinforcing steel in concrete interiors.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check for exposure and environmental conditions, specifically chemical attack. Document conditions.
2. Check for adequacy of concrete cover to protect it from corrosion. Document location and thickness of cover.
3. Perform NDT to determine corrosion activity, in this case a copper sulfate half-cell. These readings are taken on a grid basis and converted into potential gradient mapping.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Half-cell test equipment

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: EXTERIOR BLAST DEFLECTORS
CONTROL NUMBER: GS-III 22.01.05-3

Application

This guide applies to the investigation of cracks in concrete wall blast deflectors.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: EXTERIOR BLAST DEFLECTORS
CONTROL NUMBER: GS-III 22.01.05-4

Application

This guide applies to the investigation of corrosion of reinforcing steel in concrete wall blast deflectors.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check for exposure and environmental conditions, specifically chemical attack. Document conditions.
2. Check for adequacy of concrete cover to protect it from corrosion. Document location and thickness of cover.
3. Perform NDT to determine corrosion activity, in this case a copper sulfate half-cell. These readings are taken on a grid basis and converted into potential gradient mapping.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Half-cell test equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic factors.

References

1. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: GROUNDING
CONTROL NUMBER: GS-III 22.01.06-5

Application

This guide applies to the investigation of loose, corroded or broken cables, connections and bonding making up a grounding system. Do not duplicate this effort if it is being performed under an existing PM or recurring maintenance program.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Perform visual inspection, tugging straps, etc. to assure grounding is secure.
2. Test all suspect bonds/connections, cables and rods for resistance with megger meter.
3. Make sure that failed grounding system and damaged straps are tagged out until they are repaired and pass a retest.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Megger Meter
2. Cables
3. Rods - 18"
4. 5 LB Copper weights
5. 3 FT guide bars

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322, Vol. II, Inspection of Shore Facilities, 1993
2. American Electricians Handbook, Ninth Edition, McGraw-Hill, 1970
3. NAVSEA OP5, Vol. 1, Fifth Edition

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: LIGHTNING PROTECTION
CONTROL NUMBER: GS-III 22.01.07-6

Application

This guide applies to the investigation of loose, corroded or broken cables, connections and bonding making up a lightning protection system. Do not duplicate this effort if it is being performed under an existing PM or recurring maintenance program.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Perform visual inspection, tugging straps, etc. to assure grounding is secure.
2. Test all suspect bonds/connections, cables and rods for resistance with megger meter.
3. Make sure that failed grounding system and damaged straps are tagged out until they are repaired and pass a retest.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Megger Meter
2. Cables
3. Rods - 18"
4. 5 LB Copper weights
5. 3 FT guide bars

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322, Vol. II, Inspection of Shore Facilities, 1993
2. American Electricians Handbook, Ninth Edition, McGraw-Hill, 1970
3. NAVSEA OP5, Vol. 1, Fifth Edition

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7

COMPONENT: LIGHTNING PROTECTION
CONTROL NUMBER: GS-III 22.01.07-7

Application

This guide applies to the investigation of deterioration of wood masts in a lightning protection system.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Sound with hammer.
2. Bore or core (should be angled to prevent water accumulation). Plug hole with treated dowels. Examine core at the site and send to laboratory for biological studies.
3. Test with a moisture meter.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. One-pound hammer
2. Increment borer
3. Moisture meter
4. Treated wood dowels

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322, Vol. I and Vol. II, Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
3. NAVFAC MO-312, Wood Protection, 1990

APPENDIX A

ABBREVIATIONS

AIC	American Institute of Chemists
CAIS	Condition Assessment Information System
CAS	Condition Assessment Survey
DIA	Diameter
DCD	Data Collection Devices
EA	Each
FT	Foot
GS	Guide Sheet
HR	Hour
IE	That Is
IU	Inspection Unit
LBS	Pounds
LF	Linear Foot
N/A	Not Applicable
NAVFAC	Naval Facility
NAVSEA	Naval Sea Systems Command
NDT	Non-Destructive Testing
PE	Professional Engineer
PM	Preventive Maintenance
RPIL	Real Property Inventory List
SF	Square Foot
TM	Technical Manual
UOM	Unit Of Measurement

APPENDIX A

YRS	Years
WBS	Work Breakdown Structure
°	Degrees of Temperature
°C	Degrees Centigrade
°F	Degrees Fahrenheit
=	Equals
'	Feet
>	Greater Than
≥	Greater Than or Equal To
"	Inches
<	Less Than
≤	Less Than or Equal To
/	Per or Over
%	Percent
+	Plus or Positive or Add
±	Plus or Minus
–	Subtract or Minus or Negative
·	Times or By
x	Times or By

APPENDIX B

GLOSSARY

Aggregate	An inert granular material such as natural sand and gravel which when bound together into a mass by a matrix forms concrete or mortar
Baffles	A plate used to control a liquid or gas. An opaque or translucent plate used to shield a light source from direct view at certain angles. A flat deflector or obstruction designed to reduce energy transmission.
Berms	A grassy earthen cover or embankment used as a barricade to provide protection against blast. It is normally free of trash, debris and stones heavier than 10 pounds or larger than six inches in diameter. For ordnance purposes the crest of the berm must be a minimum of three feet wide.
Blast	An explosion, as of dynamite; an abrupt and damaging influence; a wave of air of increased pressure followed by one of lower pressure radiating from an explosion.
Blast Deflectors	The blast deflector is located in proximity to a door or loading dock. The side facing the activity is a reinforced concrete wall twelve inches thick at the bottom tapering to about six inches at the top. An earthen mound which bolsters the backside of the wall meets the inspection criteria and requirements of a berm. The slope of the face of this structure has a slope of six feet vertical to one foot horizontal.
Catenary	The curve made by a flexible, uniform chain or cord freely suspended between two fixed points. Designating, or of such a curve.
Cohesive Soil	A soil which when unconfined has appreciable cohesion when submerged, and considerable strength when air-dry.
Concrete Cracks	Hairline cracks are defined as shallow cracks that are the width of a human hair, normally occur in a random pattern and result in no loss of surface. Medium and larger cracks can be larger than a hairline size and normally follow a pattern and result in surface loss.
Conductor	A wire, cable, or device offering low resistance to the flow of electric current. A material that transmits heat readily. Any vertical pipe which conveys rainwater including one within a building.

APPENDIX B

Conduit	A tube or pipe used to protect electric wiring. A tube or pipe used for conveying fluid.
Continuity	Continuous effective contact of all components of an electric circuit to give it high conductance by providing low resistance.
Corrosion	The deterioration of metal or of concrete by chemical or electrochemical reaction resulting from exposure to weathering, moisture, or chemicals, or other agents in the environment in which it is placed.
Crest	The top of anything, or the line or surface along the top; summit; ridge.
Debris	Rough, broken bits and pieces of stone, wood, glass, etc. as after destruction; rubble. Bits and pieces of rubbish; litter. A heap of rocks.
Delamination	A failure in a laminated structure characterized by the separation or loss of adhesion between plies, as in built-up roofing.
Deleterious	Harmful to health, well-being; etc.; injurious.
Dielectric	A nonconductor of electricity; an insulator or insulating material.
Dissipation	A scattering or being scattered; dispersion. A wasting or squandering.
Explosive	A substance such as trinitrotoluene, or a mixture, such as gunpowder, that is characterized by chemical stability but may be made to undergo rapid chemical change without an outside oxygen source, whereupon it produces a large quantity of energy generally accompanied by the evolution of hot gases. Tending to explode; or blow up.
Exterior Blast Doors	The doors to an ordnance storage structure are of steel construction; hinged to fit snugly without sagging or binding. Some doors have louvered vents located in the lower half as part of the ventilation system. The steel doors and framing are connected to the secondary grounding system.
Flappers	A valve or movable plate for regulating the flow of air or the draft in a stove.

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Fragments	Parts broken away from the whole; broken pieces. A detached, isolated, or incomplete part.
Fusible Links	A metal chain link made of a low-melting point alloy; in case of fire, the chain breaks, thereby closing a damper, door, or the like.
Grounding	A system of electrical conductors in which at least one conductor is intentionally grounded (connected to the earth or a conducting body which serves in place of the earth) either solidly or through a current limiting device.
Gullies	A channel or hollow worn by running water; a small narrow ravine.
Half-Cell Test	In electrochemical cells, the electrical potential developed by the overall cell reaction can be considered, for calculation purposes, as the sum of the potential developed at the anode and the potential developed at the cathode, each being a half-cell. This difference in potential can be detected by placing a copper/copper sulfate half-cell on the surface of the concrete and measuring the potential differences between the reinforcing steel and a wet sponge on the concrete surface. The reference cell connects the concrete surface to a high-impedance voltmeter, which is also connected electrically to the reinforcing steel mat.
Hinges	A movable joint used to attach, support, and turn a door (or cover) about a pivot; consists of two plates joined together by a pin which supports the door and connects it to the frame, enabling it to swing open or closed.
Integrity	The quality or state of being complete; unbroken condition; entirety. The quality or state of being unimpaired; perfect condition; soundness.
Level	A horizontal line or plane; especially such a plane taken as a basis for the measure of elevation.
Life Cycle	Under normal conditions, the expected life span based on proper installation and preventive maintenance.

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Lightning Protection	An arrangement of air terminals electrically bonded with heavy copper cable tied into the primary grounding system. Both the mast and catenary systems use masts that are remote from the structure to provide the primary point for a lightning discharge. A minimum of six feet of separation must be provided from any projection of the protected structure.
Loading Dock	An elevated platform at the shipping or delivery door of a building; usually at the same height as the floor of a motor truck or railroad car to facilitate loading or unloading.
Louvered	An assembly of sloping, overlapping blades or slats; may be fixed or adjustable; designed to admit air and/or light in varying degrees and to exclude rain and snow; especially used in doors, windows, and the intake and discharge of mechanical ventilation systems.
Megger Meter	An instrument frequently used to measure high resistance. It consists of a magneto which is turned by a crank on the side of the case. The scale is calibrated directly in ohms. The resistance to be measured is connected across two terminals.
Ohmmeter	An instrument for measuring electric resistance; scale may be graduated in ohms or megohms (the unit of electrical resistance of a conductor such that a constant current of one ampere in it produces a decrease in voltage across it of one volt.
Ordnance	Military material, such as combat weapons of all kinds, with ammunition and equipment for their use, vehicles, and repair tools and machinery.
Pre-empt	To seize before anyone else can; excluding others; appropriate beforehand. To take action to check other action beforehand.
Proximity	The state or quality of being near; nearness in space, time, etc.
Resistance	The physical property of a device, conductor, element, branch, or system, by virtue of which power is lost as heat when current flows through it; the physical property which an electric conductor exhibits to the flow of current; measured in ohms.
Sag	To sink, bend, or curve, especially in the middle, from weight or pressure. To hang down unevenly or loosely.

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Scaling	The gradual and continuing loss of surface mortar and aggregate over an area; due to the failure of the cement paste caused by chemical attack or freeze/thaw cycles.
Slope	Any inclined line, surface, position, etc. (slant) Deviation from the horizontal or vertical.
Sod	The upper layer of soil covered by grass and containing the grass roots.
Spalling	A roughly circular or oval depression in the concrete. Spalls result from the separation and removal of a portion of the surface concrete, revealing a fracture roughly parallel to the surface. Spalls can be caused by corroding reinforcement steel and friction from thermal movement; reinforcing steel is often exposed.
Thermocouple	A device consisting of two junctions of two dissimilar metals, in an electric circuit; when the two junctions are at different temperatures, a voltage is generated by the device; used for measuring temperature.
Topographic	The configuration of a surface including its relief and the locations of its natural and man-made features, usually recorded on a drawing showing surface variations by means of contour lines indicating height above or below a fixed datum.
Ultrasonic Pulse Velocity Test	An ultrasonic detector is used either in scanning (non-contact) or in contact mode. The pulse velocity test uses the contact mode. A metal probe (transducer) supplied with the detector is stimulated by ultrasound and transmits the waves, when touched against equipment surfaces, to another detector. The velocity of this ultrasonic pulse is measured; the faster the pulse the more dense the material tested. The test can also detect and evaluate cracks, voids, delamination and other defects.
Ventilators	In a room or building, any device or contrivance used to provide fresh air or expel stale air.

APPENDIX C

LIFE CYCLES

22 ORDNANCE

22.01 STORAGE STRUCTURES

Concrete structures	45 YRS
Berms	100 YRS
Concrete slabs	45 YRS
Concrete loading ramps	45 YRS
Metal railing	20 YRS
Steel blast doors	25 YRS
Blast deflectors	40 YRS
Metal terminators, rods, cables	20 YRS
Metal ventilators	15 YRS

Source:

Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988